BOOK REVIEWS

Reappraisals of the Scientific Revolution. Edited by David C. Lindberg and Robert S. Westman. 1990. Cambridge University Press, New York, NY. 551 p. $59.50 cloth, $22.95 paper.

There is a difference between what happens in the world and history. History is a product of human culture. It is a selective story we tell about events, people, and the forces that influence the decisions and actions of men and women, great and not so great. By necessity, it must be selective, for the whole story is impossible, requiring detailing the lives of every single person, their interactions, natural disasters, and how these translate into social, economic, political forces and the returning impact on those same lives. History must be selective and, because of what we select as the focus of our story-telling, we may in fact tell the tale poorly by leaving out crucial factors and players, or by ignoring dimensions of the story that initially were not perceived as relevant, but on reexamination appear crucial. And so, one of the things that makes history so interesting is that it keeps changing. What happened doesn't change, but what we say about what happened changes. Furthermore, these changes occur for different reasons. Some historians may bring an ideological perspective, e.g., Marxism, to their analysis, while others may invoke grand theoretical schemes, such as historical cycles. But the most significant rewritings of history usually result from the discovery of new and informative data which causes a reevaluation of the significance placed on material previously identified as crucial or marking some sort of milepost. This kind of reevaluation is more than evident in recent work on The Scientific Revolution, a period stretching roughly from 1543 with the publication of Nicholas Copernicus' *De Revolutionibus Orbis*, to 1687, the publication date of Newton's *Principia Mathematica*. The volume under consideration here is only one of a number of works appearing recently which bring new and fresh material to light, and which expand both our knowledge of the period and the significance of the transformations that were occurring.[1]

In *Reappraisals of the Scientific Revolution* Lindberg and Westman have assembled a number of articles which serve admirably to expand our appreciation of the culture in which The Scientific Revolution took place. No longer can we rest content with the simple view that what happened in The Scientific Revolution was a two-part event in which an obsolete and "clearly false" astronomical theory which placed the earth at the center of the universe was replaced with the "true" view in which the earth and the other planets rotated about the sun, in the process of which replacement modern science was created. Nor can we remain smugly satisfied with a naive Kuhnian-type analysis in which the heart of the revolution is characterized by referring to a change of world view, as if we knew what that meant.

We still may not know what it means to speak of a change in world view, but many of the articles in this book make considerable progress in that direction, while others are not quite so successful. In thirteen chapters, we are exposed to elaborations of, as well as developments and changes in, what amounts to thirteen different aspects of the culture of primarily seventeenth century Europe. David Lindberg opens the discussion with a look at what some of the participants in the revolution thought of their own actions as well as a further look at how their actions were perceived by those who followed. Lindberg claims that from Paracelsus through Bacon, the major thinkers of the time were somehow unique in that they viewed themselves as involved in the creation of a new philosophy, a new way to look at the world, rejecting the pervasive but not monolithic Aristotelian conception. Unfortunately, this claim is not terribly persuasive. It seems that a not too detailed reading of the manifestoes of each new generation as it comes into its own would reveal constant claims that the past must be rejected in favor of the new perspective this vibrant young and energetic group of intellectuals now brings to human affairs. Just reflect on the intellectual history of the twentieth century, from the beats through the post-modernists. Everyone rejects the past in order to affirm their own version of the new order. Nor is it clear to me that the self-confidence of being engaged in revolutionary work is necessary to bring about revolutions, bravado does not seem to be a necessary condition for revolutionaries, just consider Einstein.

More important to the making of revolutions and the overturning of world views than self-proclamation seems to be the advancing and the acceptance of new modes of thinking. Ernan McMullin in his contribution concentrates on the novel methods (with the emphasis on the plurality of methods) for the analysis of nature advocated by Descartes, Bacon, and Boyle. McMullin correctly points out that the old tradition of seeing the Scientific Revolution as introducing one univocal scientific method must be revised, since several different methods were being advocated, thereby contributing to a more complicated conception of the nature of science emerging in the seventeenth century.

Gary Hatfield continues to work away at the simplified view that the revolution of the sixteenth, seventeenth, and eighteenth centuries could be characterized in broad sweeping generalizations in a wonderfully detailed analysis of the metaphysics of mathematics in the development of the new science, arguing that "When metaphysics is treated as presupposition, each major figure may be assigned a metaphysics, but we shall find that the total set of presuppositions, upon close examination, does not constitute a unified metaphysics for the new science" (p. 94).

Robert Westman, in an extremely elegant piece, argues that despite Copernicus' famous claim that "mathematics is for mathematicians," his Preface to *De Revolutionibus Orbis* was fashioned for a humanistic audience. Westman deftly argues that Copernicus used the rhetoric of renaissance humanism to elicit the patronage of key figures such as Pope Paul III and to address his work to a wide humanistic audience. In the course of his discussion we are introduced into the politics and the sociology of patronage and church reform, as well as to some of the conventions of humanistic literature, including the use of symbolism, both verbal and visual. The fascinating role of imagery and symbol is explored further by both Brian Copenhaver and William Ashworth, Jr. in two separate pieces. Copenhaver explores the fuzzy demarcation point between Hermeticism and science, while Ashworth traces the decline of occultism as scientists moved toward the development of a rigorous natural history.

In a disappointing piece John Gascoigne attempts to argue that, contrary to more standard views, the universities were not hostile to the developing new science, and in fact were instrumental in its development and dissemination. My problems with his presentation have to do with his methodology. Much of his argument is based on a procedure whereby he uses characterizations of various sixteenth and seventeenth century figures as scientists found in our contemporary *Dictionary of Scientific Biography* as a basis for the claim that the number of scientists in Italian universities increased over a two hundred year period. Unfortunately, that is not the way to go about finding out who was a scientist four hundred years ago when science as we know it did not exist. The point of this book is that the crucial period of the scientific revolution was one in which the notion of a scientist was very much in flux. Consider Newton, who viewed his work in theology and alchemy as integral with his "science." If we ignore the "non-scientific" aspects of Newton's interests, we simply get an impoverished understanding of the man, his times, and the activities in which he was engaged. To embrace Newton "warts and all" may also force us to be wary of using the term "scientist" for those who lived far away and long ago, but is that a terrible price to pay—accuracy for hero worship?

A central aspect of The Scientific Revolution was the development of new means of communication, whether through the down-playing of emblems or the development of new forms of discourse. Jan Golinski, in a fascinating piece, explores the development of chemical practice and its associated forms of communication, and argues that the standard view of the influence of the new natural philosophy on chemistry should be reconsidered.

Continuing with a sociological slant, Harold Cook examines the complicated structure of medical knowledge and practice and considers the consequences for theoretical medicine of embracing the practice of experiment so dear to the heart of the new science. It is a clear example of the depth and extent of the ramifications of accepting the new science for groups concerned with prestige and public acceptance. Michael Hunter continues on the topic of acceptance by examining the manner in which the advocates of the new science joined together to fight atheism, but raises the deep question of how to identify the target of their efforts. In a nice but subtle rejection of the view that science and religion were necessary antagonists, we are reminded of the need for science to ally itself with the most powerful institution of the day by an examination of the number of treatises showing how the new science could be utilized to fight atheism. This undercuts the sense of revolution as a sharp break and demonstrates the manner in which revolutionaries traded on ways the new science could be supportive and helpful to established institutions and beliefs.

Continuing the theme of continuity in revolution, Michael Mahoney examines some of the tactics employed by the friends and inventors of the calculus. The point here is crucial. The heart of that part of the new science known as physics was mathematics. The entrenched form of mathematics was geometry. Geometry could not handle many of the problems of the new physics. What was required was algebra and the calculus. But the calculus presented serious metaphysical problems concerning the infinitely small. So Leibniz and others presented the calculus in geometric terms, as a technique for solving troublesome geometric problems. The language was that of geometry and the problems were those of geometry. By presenting the calculus in familiar terms, Leibniz and then Newton were able to finesse the problem of having a powerful technique without a suitable metaphysical grounding, a key worry for the mathematicians of the old world view.

The collection concludes with a convincing argument by Alan Gabbey to the effect that there was not one revolution in mechanics, but many. As so many of his collaborators here have done, Gabbey rejects broad claims for an analysis of the individuals working in context. When confronting the problem of understanding what changed in mechanics, he turns naturally enough to the questions with which the scientists themselves were interested. And so we are treated to a nice survey of the problems in mechanics which intrigued people like Roberval, Baldi, and Descartes. There was no one problem and, as might be expected, for each problem different methods were appropriate. Likewise, some problems faded from interest, others continued and new ones also emerged. In short, if science is a problem-solving activity then by looking at the problems scientists were trying to solve we can get some sense of the changes that took place over a specific period of time. It seems there were many changes, leaving us, not surprisingly, without a clean cut revolution to point to.

These essays vary in technical difficulty. But they are well written and fully accessible. The range is considerable. And the complexity of the times and the issues is clearly laid out. For the most part these essays are good examples of the new contextualized history and philosophy of science that is clearly coming into its own. It is no longer possible to generalize cavalierly about The Scientific Revolution. We know too much. And the lesson to be learned is that we should be very careful about generalizing about science in any period. It is all too complicated and too interesting to be done the disservice of being summed up in a phrase. To have helped bring us to this point, the editors have performed a valuable service.

[1]See for example *Revolution and Continuity* edited by Peter Barker and Roger Ariew, Washington: Catholic University Press, Studies in Philosophy and the History of Philosophy, Vol. 24, 1991.

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Writing Scientific Programs Under the OS/2 Presentation Manager. James W. Cooper. 1990. John Wiley and Sons, Inc., New York, NY. 403 p. $39.95 paper.

The decade of the 80s saw a veritable explosion of advances in computer technology. These advances are perhaps most apparent in the area of microcomputer hardware, where each new generation of microprocessor is faster and more powerful than its predecessor: today's microcomputers rival and in some cases exceed the capabilities of yesterday's minicomputers. The situation has been exactly the same in the areas of memory, display screen, and printing technologies: decreasing costs and increasing capabilities. There have also been important developments in microcomputer software, perhaps none more significant than that of the graphical user interface or GUI. Made popular by Apple's Macintosh microcomputer, GUIs display information visually through icons and pull-down and pop-up menus and the user typically interacts with the system visually using a mouse. The introduction of GUIs has had the effect of standardizing application interfaces, e.g., the command to "load" a file is the same in every application program: word processor, spreadsheet, database, etc. This standardization, combined with the visual nature of these interfaces, has made it much easier for users to learn to use application programs productively. For IBM and compatible PCs the dominant GUI is Microsoft's Windows, an operating environment currently based on the DOS operating system.

For any computer, the single most important piece of software is the operating system: a collection of programs that manage the computer's resources including files, memory, and peripheral devices. All application programs depend on the operating system to carry out such tasks as loading/saving files, printing, etc. As a consequence, the capabilities (and limitations) of an application program are defined to a very large extent by the operating system for which it is written.

Since their introduction in the early 80s virtually all IBM and compatible PCs used some flavor of DOS for their operating system. Over the years, several major revisions were made to DOS to allow it to accommodate the latest hardware advances. However, by the late 80s the capabilities and uses for microcomputers had grown beyond what DOS could be made to provide and a completely new operating system, OS/2, was developed to support the PC into the next century. Some of the new capabilities of OS/2 are: a "built-in" standardized GUI, the ability to access considerably larger amounts of memory, and the ability to do multitasking and to run multithreaded programs. The latter two capabilities mark a milestone in IBM PC history. A multitasking operating system allows more than one program to be running at the same time. Thus while the spreadsheet is being recalculated, the user can switch over to the word processor and then switch back again when the recalculation is complete, all without having to reload any programs. A multithreaded program is one in which several "specialist" programs run concurrently, cooperating and communicating with each other to accomplish some goal. These and other features make OS/2 extremely powerful and although it has not yet replaced DOS as the standard operating system for this class of machines, virtually everyone agrees that it is simply a matter of time.

While OS/2, with its GUI and increased capabilities is easier for users to work with, it is somewhat more complicated to write application programs for. James Cooper's book is a tutorial/text for programmers who wish to do so. The book addresses three aspects of OS/2 programming. The first and the largest (13 of 24 chapters) component covers the development of programs using the OS/2 Presentation Manager toolkit. The toolkit allows the programmer to readily construct programs with pull-down and pop-up menus, graphics, etc. The author does a very good job of presenting the relevant information; examples are well thought out and executed. Each chapter basically begins with a programming problem, e.g., how to write a program to generate a bar chart. The solution to the problem is first discussed and outlined, and the portions of the toolkit necessary to solve the problem are introduced and explained. Each portion of the example program is explained in detail as it is being written, giving the reader a very good understanding of the sample program and the underlying concepts.

The other two major components of the book deal with multitasking and multithreaded program issues and writing device drivers. Both of these topics would be of particular interest for scientific programmers. Device drivers are used to program interface cards which can be used to gather data from scientific experiments. The multithread feature could be used to write a program which simultaneously collects experimental data, processes it, and displays the results. Both of these topics are fairly complicated and require a good deal of explanation. However, the author has given only a brief (two chapters) overview of multitasking and multithreaded programs. This is disappointing since multitasking/multithreading is one of the primary reasons one might choose to use OS/2 over Windows. The discussion of device drivers is well done, although also somewhat limited in scope. Cooper chooses a specific interface card and painstakingly describes the details of writing a device driver for this particular card.

On the whole, the technical exposition in this book is well done. The overall organization of topics is good, although the chapters on printing graphics and communicating through serial ports are poorly motivated and are not well integrated into the rest of the text. The writing style is appropriate for a book on a topic that is as technical as this one is. However, each chapter ends very abruptly; it would be useful to have some concluding comments summarizing the main points of the chapter and how portions of the example program might be generalized and/or applied in different contexts. Likewise, as the title of the book refers to scientific programs, it would be beneficial to see a sample scientific program which unifies the three principal topics.

This book would be most useful to experienced C programmers who wish to write programs for OS/2. Thus it is unclear what purpose the chapter on C programming serves, since an experienced programmer will not need it and an inexperienced programmer will not learn to program in C from reading this chapter (as the author claims in the preface). Likewise for the chapter on assembly language programming. Overall, the shortcomings of the text are probably minor considering the actual audience and the experienced programmer will likely be able to glean much useful information from this book.

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Improving America's Diet and Health: From Recommendations to Action. Edited by Paul R. Thomas. 1991. National Academy Press, Washington, DC. 239 p. $29.95 hardcover.

"In late 1987, the Henry J. Kaiser Family Foundation and the National Cancer Institute commissioned the National Academy of Sciences to develop a comprehensive plan to implement the dietary guidelines as a means to improve the health of Americans and to assess the possible consequences of implementing the plan." The preceding statement is taken from this book's Preface and indicates the charge given to an interdisciplinary Committee on Dietary Guidelines Implementation from the Institute of Medicine's Food and Nutrition Board and the Committee on Diet and Health.

Admittedly, this public policy report does not provide a blueprint for carrying out a coordinated, national effort to improve dietary patterns in the United States. The recommendations are general but practical and attainable when considering the contemporary political, economic, and social environments. The recommendations, however, are detailed enough to provide adequate direction for implementing dietary guidelines; they have been made less on the basis of experimental data and more on considered professional judgement.

Although the focus of this report is on improving dietary patterns, the Committee emphasizes that diet is only one important determinant of health and well-being. Various personal behaviors and other factors also are strongly linked to risks of disease and should not be neglected. Chapter 3 provides extensive review of current theory and practice and suggests that it is possible to modify food preferences and eating patterns in this country. Chapter 4 interprets the nine dietary recommendations of the *Diet and Health Report* and provides general guidance for their use in selecting and preparing foods and in constructing healthful diets. The guidance is also relevant to the implementation of the recent sets of dietary guidelines.

In Chapters 5, 6, 7, and 8, specific strategies and associated actions developed for the public sector, the private sector, for health-care professionals, and in education for the public, respectively, are described. These groupings have identified effectively the main interventions that have been attempted and have recommended those that might be undertaken. In view of the increasing interest in preventive over reparative practices, the discussion within this section highlights the multiple roles provided by practitioners, business, service agencies, organizations and foundations, government, and educational units.

The three primary strategies recommended by the Committee in support of the implementation of the dietary recommendations across all divisions are, as follows:

1. Governments and health-care professionals must become more active as policymakers, role models, and agenda setters . . .
2. Improve the nutrition knowledge of the public and increase the opportunities to practice good nutrition.
3. Increase the availability of health-promoting food.

Finally, the Committee report identifies in Chapter 9 the six broad areas of research in which more activity is required as part of the implementation. If the majority of the U.S. population is to eat in ways that conform to the dietary recommendations, the achievement of the goal depends on the model of allowing very high levels of collaboration among those units involved in providing nutrition information, education, and food to the public.

To that end, *Improving America's Diet and Health* provides a useful, qualitative reference to convert recommendations into action. It is specific in content while addressing multifaceted questions, concerns, and needs; it is a valued reference for educators, policymakers, health-care professionals, the food industry, and responsible individuals.

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Major Events in the History of Life. Edited by J. William Schopf. 1992. Jones and Bartlett Publishers, Boston, Massachusetts. 190 pp.

This book contains the proceedings of a symposium on the "Major Events in the History of Life" which was held at the University of California on 11 January 1991. The volume is divided into six chapters written by acknowledged experts in their fields.

Stanley Miller was an excellent choice for Chapter 1 which deals with "The Prebiotic Synthesis of Organic Compounds as a Step Toward the Origin of Life." A multitude of fascinating, unanswered questions are posed by Miller. Because of the radically different prebiotic earth environment as compared to the present, many of the optimal conditions for the origin of life sometimes seem counterintuitive. One example of this is the idea that dry heat between 150° to 180° C is most favorable for polymerization of the precursors of life. Miller also states that contrary to popular belief, a cold, concentrated soup would be a more likely environment for the development of the chemicals of life since the ratio of the rate of synthesis to the rate of decomposition would be greatest in these conditions.

In Chapter 2 J. William Schopf discusses the earliest fossils dating back to the Precambrian eon. Fascinating questions are raised, such as: "Why are we bilateral . . . Why are we self-aware . . . Why do we breathe oxygen?" Schopf notes that the multitudes of Precambrian organisms can reveal much about our own species. This chapter is a delightful mixture of stromatolites, microfossils, fubaritic (fouled up beyond all recognition) rocks, and CHONSP (the elements from which all living systems are composed). Schopf's chapter makes lively reading as evidenced by his assertion that ". . . cyanobacteria – pond scum – had rusted the world!"

Bruce Runnegar next devotes a chapter to the earliest animals. He begins with the simple statement that, "All animals are descended from a single species that lived some time during the later Precambrian." This contains riveting descriptions of the "legless lobopods, naked halkieriads and toothed terrors" of Cambrian times, and Stephen Jay Gould's "sigmoid fraud," which refers to the log phase in the growth of animal diversity.

Chapter 4 on the origin and evolution of the earliest land plants is by John B. Richardson. This section is a bit turgid and laden with technical jargon. It would have been useful if the passage on mosaic evolution in plants would have been presented in the introduction. The knowledge that spores evolve faster than stems, roots, and leaves may give readers the fortitude to continue plunging through the morass of botanical terms. In Chapter 5, John Ostrom describes the history of vertebrates. Ostrom gives a concise characterization of the vertebrate Bauplan as a "cephalized, sensate, bilaterally symmetrical, motile, coelomate, gnathostome having a segmented endoskeleton, dorsal hollow nerve chord, and a ventral gut." Ostrom reveals to us why living reptiles do not chew their food but all ceratopsians (horned dinosaurs) were sophisticated masticators. The fabulous world of the dinosaurs and our mammalian ancestors, who at that time were no larger than a house cat, is described in a very readable fashion.

The last chapter, by Phillip V. Tobias, is a description of the "Major Events in the History of Mankind." Perhaps the one flaw in Tobias' section is his constant use of Man and Mankind when referring to humans and humankind. Otherwise, the chapter contains a well-written and easily understood account of the latest theories on the origin of modern humans from the graceful Australopithecines of ancient times.

This book will be a valuable addition to the bookshelves of all who are interested in science. One of its most important functions may be in its skillful interweaving of the best and most up-to-date knowledge on the history of life on earth. A book like this would serve as a perfect capstone to a science major's undergraduate course of study. Graduate students and practicing scientists will find a treasure trove of ideas and new and refreshing ways of looking at problems. This book could very well serve as a text in a general or integrated science college class. Too often knowledge remains compartmentalized and unaccessible to scholars in other fields. Contributions like this are a step in the right direction and they will be needed if our schools and universities are to provide scientific literacy for all.

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